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10/700,991	11/03/2003	Vahid Tarokh	MN1-004US	5626

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EXAMINER	
LAM, DUNG LE	

ART UNIT	PAPER NUMBER
2687	

DATE MAILED: 03/01/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Supplementary Notice of Allowability	**Application No.** 10/700,991	**Applicant(s)** TAROKH ET AL.	
	Examiner Dung Lam	**Art Unit** 2687	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *11/04/05*.

2. ☒ The allowed claim(s) is/are *1, 9, 10,11,16,17, 19-41,49-51, 56-57 and 59-80*.

3. ☐ The drawings filed on _____ are accepted by the Examiner.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☒ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

SUPPLEMENTARY EXAMINER'S AMENDMENT

1. Please replace all claims as shown below.

1. (currently amended) A method for use in a wireless communication system, the method comprising:

outputting at least one signal suitable for causing a smart antenna to transmit at least one complementary beam, said at least one signal being operatively configured to cause said smart antenna to perform single beam complementary beamforming (SBCBF);

causing said smart antenna to transmit said at least one complementary beam based on said at least one signal; and

configuring said at least one signal to cause said smart antenna to perform said SBCBF by transmitting energy at a detectable transmit power level in all smart antenna-supported directions while substantially preserving a shape of at least one main transmit beam having a transmit power level that is significantly greater than said detectable transmit power level, said SBCBF being operatively performed by said smart antenna that is operatively associated with a base station within a wireless communication system, said base station including a Butler matrix network configured to form said at least one main beam using said smart antenna, and further configured to provide at least one of post-combining SBCBF or pre-combining SBCBF.

2-8. (canceled)

9. (currently amended) ~~The method as recited in Claim 1, wherein~~ A method for use in a wireless communication system, the method comprising:

outputting at least one signal suitable for causing a smart antenna to transmit at least one complementary beam, said at least one signal ~~is~~ being operatively configured to cause said smart antenna to perform subspace complementary beamforming (SCBF), and said at least one signal including *N-K* data streams operatively configured to cause said smart antenna to transmit energy in at least one side lobe;

determining said at least one signal by using a Downlink Beamforming Matrix: $W = U\Lambda V^H$;

determining said at least one signal by using a Steering Matrix: $A = [a(\theta_1) \quad a(\theta_2) \quad \cdots \quad a(\theta_K)]$, wherein $a(\theta_k)$ represents a steering vector of user k; and wherein:

if $W = A^* B$, where *B* is a non-singular *K*-by-*K* matrix, then using a complementary beamforming matrix of

$$W^c = \sqrt{\frac{k_0 C_0}{N}} [u_{K+1} \quad u_{K+2} \quad \cdots \quad u_N]$$

wherein $C_0 = Nc_0$ is the level of the main lobe, k_0 is the scaling factor and u_l is the l-th column vector of $U_\perp$
otherwise using a complementary beamforming matrix of

$$W^c = \sqrt{\frac{k_0 C_0}{N}}\left[\bar{u}_1 \quad \bar{u}_2 \quad \cdots \quad \bar{u}_{N-K}\right]$$

wherein $\bar{u}_l$ is the l-th left singular vector of the matrix

$\left(\sum_{l=K+1}^{N} \tilde{u}_l \tilde{u}_l^H\right) U\Lambda^c = \overline{U\Lambda}\overline{V}^H$, and $A^* = \tilde{U}\tilde{\Lambda}\tilde{V}^H$ is assumed, and in scattering channel $H^* = \tilde{U}\tilde{\Lambda}\tilde{V}^H$ is assumed.

10. (original) The method as recited in c[[C]]laim 9, further comprising: determining said at least one signal by selectively modifying a weight matrix to operatively support said SCBF.

11. (original) The method as recited in c[[C]]laim 9, further comprising: determining said at least one signal by selectively expanding a size of a weight matrix to operatively support said SCBF.

12-15. (canceled)

16. (currently amended) The method as recited in c[[C]]laim ~~15~~ 9, wherein it is assumed that $2K<N$,

$W_a = \left[W \quad A^*\right] = U_a \Lambda_a V_a^H$, and $W^c = \sqrt{\frac{k_0 C_0}{N}}\left[u_{a,r+1} \quad u_{a,r+2} \quad \cdots \quad u_{a,N}\right]$,

and wherein r is rank of W_a.

17.(currently amended) ~~The method as recited in Claim 1, wherein~~ A method for use in a wireless communication system, the method comprising:
outputting at least one signal suitable for causing a smart antenna to transmit at least one complementary beam, said at least one signal ~~is~~ being operatively configured to cause said smart antenna to perform complementary superposition beamforming (CSBF); and
determining said at least one signal by using a downlink beamforming matrix: $\widetilde{W} = [w_1 \ \cdots \ w_{k-1} \ \ \widetilde{w}_k \ \ w_{k+1} \ \cdots \ w_K]$, where $\widetilde{w}_k = p_0 w_k + W^c p$ and p is complex conjugate transpose of the l-th row of W^c, $p_0 = \frac{w_{k,l}^*}{|w_{k,l}|}$ is normalized complex conjugate of the l-th element of w_k.

18.(canceled)

19.(currently amended) The method as recited in c[[C]]laim ~~18~~ 17, wherein W^c is associated with subspace complementary beamforming (SCBF).

20.(original) The method as recited in c[[C]]laim 17, further comprising: determining said at least one signal by using $\widetilde{W} = [w_1 \ \ w_2 \ \cdots \ w_K \ \ W^c p]$.

21.(original) The method as recited in c[[C]]laim 17, further comprising: determining said at least one signal by using a null-generation technique that is configured to generate L nulls at angles $\theta_1, \theta_2, \cdots, \theta_L$ at a beam.

22.(original) The method as recited in c[[C]]laim 17, further comprising: determining said at least one signal by using $A = [a(\theta_1) \ \ a(\theta_2) \ \cdots \ a(\theta_L)]$.

23.(original) The method as recited in c[[C]]laim 17, further comprising: determining said at least one signal by projecting w onto orthogonal complement subspace of column space A^*.

24.(original) The method as recited in c[[C]]laim 17, further comprising: determining said at least one signal by using a vector: $w = (I - P_S)w$ where $P_S = A^*(A^T A^*)^{-1} A^T$, and in scattering channel $P_S = H^*(H^T H^*)^{-1} H^T$.

25.(original) The method as recited in c[[C]]aim 17, further comprising: determining said at least one signal by using a null-widening technique that is configured to produce at least one null at a vicinity of selected angles.

26.(original) The method as recited in c[[C]]laim 17, further comprising: determining said at least one signal by selectively modifying a steering matrix to: $A = [\tilde{a}(\theta_1) \quad \tilde{a}(\theta_2) \quad \cdots \quad \tilde{a}(\theta_K)]$ wherein $\tilde{a}(\theta_k) = [a(\theta_k - \Delta\theta_l) \quad a(\theta_k) \quad a(\theta_k + \Delta\theta_r)]$.

27.(original) The method as recited in c[[C]]laim 17, further comprising: determining said at least one signal by establishing at least two nulls such that a rank of *A* is less than *N*.

28.(original) The method as recited in c[[C]]laim 17, further comprising: determining said at least one signal by using adaptive control of a complementary beam level.

29.(original) The method as recited in c[[C]]laim 17, further comprising: determining said at least one signal by, in a non-zero angular channel, selectively reducing a complementary beam level.

30.(original) The method as recited in c[[C]]laim 17, further comprising: determining said at least one signal by, for delay spread channels, selectively reducing a complementary beam level.

31.(original) The method as recited in c[[C]]aim 17, further comprising: determining said at least one signal by, in free space, selectively increasing the complementary beam level.

32.(original) The method as recited in c[[C]]aim 1, wherein outputting said at least one signal suitable for causing said smart antenna to transmit at least one complementary beam further includes:
using a zero-forcing beamformer to output said at least one signal.

33.(original) The method as recited in c[[C]]laim 1, wherein outputting said at least one signal suitable for causing said smart antenna to transmit at least one complementary beam further includes:
using a maximum SINR beamformer to output said at least one signal.

34. (currently amended) ~~The method as recited in Claim 1, wherein outputting said at least one signal suitable for causing said smart antenna to transmit at least one complementary beam further includes:~~
A method for use in a wireless communication system, the method comprising:

outputting at least one signal suitable for causing a smart antenna to transmit at least one complementary beam, wherein said outputting includes selectively constructing a plurality of matrices Z_1, Z_1, ..., Z_L, where L is a length of a downlink transmission period, such that said plurality of matrices satisfy at least one property selected from a group of properties comprising:

(a) for all $1 \le i \le L$, a matrix Z_i is a $k \times m$ matrix whose rows are in a set {0, $\pm U_0^H, \pm U_1^H, \ldots, \pm U_{m-k-1}^H$};

(b) if L is even, then, $Z_2 = -Z_1$, $Z_4 = -Z_3$, ..., $Z_L = -Z_{L-1}$;

(c) if L is odd, then $Z_2 = -Z_1$, $Z_4 = -Z_3$, ..., $Z_{L-1} = -Z_{L-2}$, $Z_L = 0$; and

(d) each element $+U_0^H$, $-U_0^H$, $+U_1^H$, $-U_1^H$, ..., $+U_{m-k-1}^H$, $-U_{m-k-1}^H$ appear p times in a list of Lk rows of Z_1, Z_1, ..., Z_L for some positive integer p.

35. (original) The method as recited in c[[C]]laim 34, wherein rows of Z_{2i-1} are, respectively, $U_{0\oplus i}^H$, $U_{1\oplus i}^H$, ..., $U_{k-1\oplus i}^H$ and where $i \oplus j$ denote $(i + j)$ mod $(m-k)$ for $i = 1, 2, 3, \ldots, [L/2]$ and wherein $Z_{2i} = -Z_{2i-1}$.

36. (original) The method as recited in c[[C]]laim 34, further comprising:

using as a beamforming matrix:

$$S^t = \left[\left(A^H A\right)^{-1} A^H / \sqrt{Tr\left(\left(A^H A\right)^{-1}\right)} + \frac{1}{\sqrt{k}} \varepsilon Z_i \right]$$

where $\varepsilon \ge 0$ is a fixed positive number.

37. (original) The method as recited in c[[C]]laim 36, wherein said complementary beam is configured to cause a loss of at most $10 \log_{10}\left(1+|\varepsilon|^2\right)$ in a received signal for an intended recipient.

38. (original) The method as recited in c[[C]]laim 36, wherein said complementary beam is configured to direct a portion:

$$|\varepsilon|^2 \frac{\sum_{j=1}^{m} |b_j|^2}{m}$$

of a resulting transmitted power to another recipient whose spatial signature is $B=(b_1, b_2, ..., b_m)$.

39. (original) The method as recited in c[[C]]laim 1, wherein outputting said at least one signal suitable for causing said smart antenna to transmit at least one complementary beam further includes:

outputting said signal based on at least a complementary beamforming matrix at time t given by:

$$S^t = \left[\left(A^H A\right)^{-1} A^H / \sqrt{Tr\left(\left(A^H A\right)^{-1}\right)} + \frac{1}{\sqrt{k}} \varepsilon Z_t \right].$$

40. (original) The method as recited in c[[C]]laim 1, wherein outputting said at least one signal suitable for causing said smart antenna to transmit at least one complementary beam further includes:

outputting said signal based on at least matrices $P_0, P_1, ..., P_{m-k}$ having rows, respectively, $U_0^H, U_1^H, ..., U_{m-k}^H$ and wherein a fixed beamforming matrix is given by:

$$S = \left[\left(A^H A\right)^{-1} A^H / \sqrt{Tr\left(\left(A^H A\right)^{-1}\right)} + \frac{1}{\sqrt{k}} \varepsilon \sum_{i=1}^{m-k} P_i \right].$$

41. (currently amended) An apparatus for use in a wireless communication system, the apparatus comprising:
a smart antenna operatively coupled to receive at least one signal and configured to transmit at least one complementary beam based on said at least one signal; and
circuitry configured to output said at least one signal suitable for causing [[a]] the smart antenna to transmit said at least one complementary beam, said at least one signal being operatively configured to cause said smart antenna to perform single beam complementary beamforming (SBCBF), said at least one signal being configured by said circuitry to cause said smart antenna to perform said SBCBF by transmitting energy at a detectable transmit power level in all smart antenna-supported directions while substantially preserving a shape of at least one main transmit beam having a transmit power level that is significantly greater than said detectable transmit power level, said smart antenna being operatively associated with a base station within the wireless communication system, said base station including at least a portion of said circuitry which includes a Butler matrix network configured to form said at least one main beam using said smart antenna, and said Butler matrix network being configured to provide at least one of post-combining SBCBF or pre-combining SBCBF.

42-48. (canceled)

49. (currently amended) ~~The apparatus as recited in Claim 41, wherein~~ An apparatus for use in a wireless communication system, the apparatus comprising:
circuitry configured to output at least one signal suitable for causing a smart antenna to transmit at least one complementary beam, said at least one signal ~~is~~ being operatively configured to cause said smart antenna to perform subspace complementary beamforming (SCBF), and said at least one signal including *N-K* data streams operatively configured to cause said smart antenna to transmit energy in at least one side lobe; wherein:
said circuitry is configured to determine said at least one signal by using a Downlink Beamforming Matrix: $W = U\Lambda V^H$;
said circuitry is configured to determine said at least one signal by using a Steering Matrix: $A = [a(\theta_1) \quad a(\theta_2) \quad \cdots \quad a(\theta_K)]$, wherein $a(\theta_k)$ represents a steering vector of user k; and wherein:
if $W = A^* B$, where *B* is a non-singular *K*-by-*K* matrix, then said circuitry is configured to use a complementary beamforming matrix of

$$W^c = \sqrt{\frac{k_0 C_0}{N}} [u_{K+1} \quad u_{K+2} \quad \cdots \quad u_N]$$

wherein $C_0 = Nc_0$ is the level of the main lobe, k_0 is the scaling factor and u_l is the *l*-th column vector of U,
otherwise said circuitry is configured to use a complementary beamforming matrix of

$$W^c = \sqrt{\frac{k_0 C_0}{N}}[\bar{u}_1 \quad \bar{u}_2 \quad \cdots \quad \bar{u}_{N-K}]$$

wherein $\bar{u}_l$ is the *l*-th left singular vector of the matrix

$\left(\sum_{l=K+1}^{N} \tilde{u}_l \tilde{u}_l^H\right) U\Lambda^c = \overline{U\Lambda}\overline{V}^H$, and $A^* = \tilde{U}\tilde{\Lambda}\tilde{V}^H$ is assumed, and in scattering channel $H^* = \tilde{U}\tilde{\Lambda}\tilde{V}^H$ is assumed.

50. (original) The apparatus as recited in c[[C]]laim 49, wherein said circuitry is configured to determine said at least one signal by selectively modifying a weight matrix to operatively support said SCBF.

51. (original) The apparatus as recited in c[[C]]laim 49, wherein said circuitry is configured to determine said at least one signal by selectively expanding a size of a weight matrix to operatively support said SCBF.

52-55. (canceled)

56. (currently amended) The apparatus as recited in c[[C]]laim ~~55~~ 51, wherein said circuitry is configured such that $2K<N$,

$W_a = [W \quad A^*] = U_a \Lambda_a V_a^H$, and $W^c = \sqrt{\frac{k_0 C_0}{N}}[u_{a,r+1} \quad u_{a,r+2} \quad \cdots \quad u_{a,N}]$,

and wherein *r* is rank of W_a.

57.(currently amended) ~~The apparatus as recited in Claim 41, wherein~~ An apparatus for use in a wireless communication system, the apparatus comprising: circuitry configured to output at least one signal suitable for causing a smart antenna to transmit at least one complementary beam, said circuitry ~~is~~ being configured such that said at least one signal causes said smart antenna to perform complementary superposition beamforming (CSBF); and wherein
said circuitry is configured to determine said at least one signal by using a downlink beamforming matrix: $\widetilde{W} = [w_1 \ \cdots \ w_{k-1} \ \ \widetilde{w}_k \ \ w_{k+1} \ \cdots \ w_K]$, where
$\widetilde{w}_k = p_0 w_k + W^c p$ and p is complex conjugate transpose of the l-th row of W^c,
$p_0 = \frac{w_{k,l}^*}{|w_{k,l}|}$ is normalized complex conjugate of the l-th element of w_k.

58. (canceled)

59.(original) The apparatus as recited in c[[C]]laim ~~58~~ 57, wherein W^c is associated with subspace complementary beamforming (SCBF).

60.(original) The apparatus as recited in c[[C]]laim 57, wherein said circuitry is configured to determine said at least one signal by using
$\widetilde{W} = [w_1 \ \ w_2 \ \cdots \ w_K \ \ W^c p]$.

61.(original) The apparatus as recited in c[[C]]laim 57, wherein said circuitry is configured to determine said at least one signal by using a null-generation technique that is configured to generate L nulls at angles $\theta_1, \theta_2, \cdots, \theta_L$ at a beam.

62.(original) The apparatus as recited in c[[C]]laim 57, wherein said circuitry is configured to determine said at least one signal by using
$A = [a(\theta_1) \ \ a(\theta_2) \ \cdots \ a(\theta_L)]$.

63.(original) The apparatus as recited in c[[C]]laim 57, wherein said circuitry is configured to determine said at least one signal by projecting w onto orthogonal complement subspace of column space A^*.

64.(original) The apparatus as recited in c[[C]]laim 57, wherein said circuitry is configured to determine said at least one signal by using a vector: $w = (I - P_S)w$
where $P_S = A^* (A^T A^*)^{-1} A^T$, and in scattering channel $P_S = H^* (H^T H^*)^{-1} H^T$.

65.(original) The apparatus as recited in c[[C]]laim 57, wherein said circuitry is configured to determine said at least one signal by using a null-widening technique that is configured to produce at least one null at a vicinity of selected angles.

66.(original) The apparatus as recited in c[[C]]laim 57, wherein said circuitry is configured to determine said at least one signal by selectively modifying a steering matrix to:

$$A = \left[\tilde{a}(\theta_1) \quad \tilde{a}(\theta_2) \quad \cdots \quad \tilde{a}(\theta_K)\right]$$

wherein $\tilde{a}(\theta_k) = \left[a(\theta_k - \Delta\theta_l) \quad a(\theta_k) \quad a(\theta_k + \Delta\theta_r)\right]$.

67.(original) The apparatus as recited in c[[C]]laim 57, wherein said circuitry is configured to determine said at least one signal by establishing at least two nulls such that a rank of *A* is less than *N*.

68.(original) The apparatus as recited in c[[C]]laim 57, wherein said circuitry is configured to determine said at least one signal by using adaptive control of a complementary beam level.

69.(original) The apparatus as recited in c[[C]]laim 57, wherein said circuitry is configured to determine said at least one signal by, in a non-zero angular channel, selectively reducing a complementary beam level.

70.(original) The apparatus as recited in c[[C]]laim 57, wherein said circuitry is configured to determine said at least one signal by, for delay spread channels, selectively reducing a complementary beam level.

71.(original) The apparatus as recited in c[[C]]laim 57, wherein said circuitry is configured to determine said at least one signal by, in free space, selectively increasing the complementary beam level.

72.(original) The apparatus as recited in c[[C]]laim 41, wherein said circuitry employs a zero-forcing beamformer to output said at least one signal.

73.(original) The apparatus as recited in c[[C]]laim 41, wherein said circuitry employs a maximum SINR beamformer to output said at least one signal.

74.(currently amended) ~~The apparatus as recited in Claim 41, wherein~~ An apparatus for use in a wireless communication system, the apparatus comprising:

circuitry configured to output at least one signal suitable for causing a smart antenna to transmit at least one complementary beam, said circuitry ~~is~~ being configured to construct a plurality of matrices Z_1, Z_1, ..., Z_L, where L is a length of a downlink transmission period, such that said plurality of matrices satisfy at least one property selected from a group of properties comprising:

(a) for all $1 \le i \le L$, a matrix Z_i is a $k \times m$ matrix whose rows are in a set {0, $\pm U_0^H, \pm U_1^H, \ldots, \pm U_{m-k-1}^H$};

(b) if L is even, then, $Z_2 = -Z_1$, $Z_4 = -Z_3$, ..., $Z_L = -Z_{L-1}$;

(c) if L is odd, then $Z_2 = -Z_1$, $Z_4 = -Z_3$, ..., $Z_{L-1} = -Z_{L-2}$, $Z_L = 0$; and

(d) each element $+U_0^H$, $-U_0^H$, $+U_1^H$, $-U_1^H$, ..., $+U_{m-k-1}^H$, $-U_{m-k-1}^H$ appear p times in a list of Lk rows of Z_1, Z_1, ..., Z_L for some positive integer p.

75.(original) The apparatus as recited in c[[C]]laim 74, wherein rows of Z_{2i-1} are, respectively, $U_{0\oplus i}^H$, $U_{1\oplus i}^H$, ..., $U_{k-1\oplus i}^H$ and where $i \oplus j$ denote $(i + j)$ mod $(m-k)$ for $i = 1$, 2, 3, ..., [L /2] and wherein $Z_{2i} = -Z_{2i-1}$.

76.(currently amended) The apparatus as recited in c[[C]]laim 74 ~~34~~, wherein said circuitry is ~~configurted~~ configured to construct a beamforming matrix:

$$S^t = \left[\left(A^H A\right)^{-1} A^H / \sqrt{Tr\left(\left(A^H A\right)^{-1}\right)} + \frac{1}{\sqrt{k}} \varepsilon Z_i \right]$$

where $\varepsilon \ge 0$ is a fixed positive number.

77.(original) The apparatus as recited in c[[C]]laim 76, wherein said complementary beam is configured to cause a loss of at most $10 \log_{10}\left(1+|\varepsilon|^2\right)$ in a received signal for an intended recipient.

78.(original) The apparatus as recited in c[[C]]laim 76, wherein said complementary beam is configured to direct a portion:

$$|\varepsilon|^2 \frac{\sum_{j=1}^{m}|b_j|^2}{m}$$

of a resulting transmitted power to another recipient whose spatial signature is $B=(b_1,b_2,...,b_m)$.

79. (original) The apparatus as recited in c[[C]]laim 41, wherein said circuitry is configured to output said signal based on at least a complementary beamforming matrix at time t given by:

$$S^t=\left[\left(A^HA\right)^{-1}A^H/\sqrt{Tr\left(\left(A^HA\right)^{-1}\right)}+\frac{1}{\sqrt{k}}\varepsilon Z_t\right].$$

80. (original) The apparatus as recited in c[[C]]laim 41, wherein said circuitry is configured to output said signal based on at least matrices $P_0,P_1,...,P_{m-k}$ having rows, respectively, $U_0^H,U_1^H,...,U_{m-k}^H$ and wherein a fixed beamforming matrix that is used is given by:

$$S=\left[\left(A^HA\right)^{-1}A^H/\sqrt{Tr\left(\left(A^HA\right)^{-1}\right)}+\frac{1}{\sqrt{k}}\varepsilon\sum_{i=1}^{m-k}P_i\right].$$

Allowable Subject Matter

1. Claims *1, 9, 10,11,16,17, 19-41,49-51, 56-57 and 59-80* are allowed.

The examiner's reason for allowing the independent claims 1, 9, 17, 34, 41, 49, 57, 74 presented is based on Applicant's Remarks filed on 11/04/05 and the above examiner amendments.

Regarding claims 32,33,39,40, 10,11,16, 19-31, 35-36, 72-73, 50,51,56, 59-71 and 75-80, the claims are allowed as being dependent of claims 1, 9, 17, 34, 41, 49, 57 and 74, respectively.

Conclusion

2. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

3. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dung Lam whose telephone number is 571-272-6497. The examiner can normally be reached on Monday - Friday 8AM - 5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lester Kincaid can be reached on 571-272-7922. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

DL

2/03/05

SONNY TRINH
PRIMARY EXAMINER